

Low Power, High Slew Rate Wideband Operational Amplifier

March 1993

Features

- Low Supply Current.....7.5mA
- High Slew Rate.....340V/ μ s
- Open Loop Gain.....25kV/V
- Wide Gain-Bandwidth ($A_v \geq 10$).....470MHz
- Full Power Bandwidth.....5.4MHz
- Low Offset Voltage.....0.6mV
- Input Noise Voltage.....11nV/ $\sqrt{\text{Hz}}$
- Differential Gain/Phase.....0.04%/0.04°
- Lower Power Enhanced Replacement for AD840 and EL2040

Applications

- Pulse and Video Amplifiers
- Wideband Amplifiers
- High Speed Sample-Hold Circuits
- Fast, Precise D/A Converters

Description

The HA-2850 is a wideband, high slew rate, operational amplifier featuring superior speed and bandwidth characteristics. Bipolar construction, coupled with dielectric isolation, delivers outstanding performance in circuits with a closed loop gain of 10 or greater.

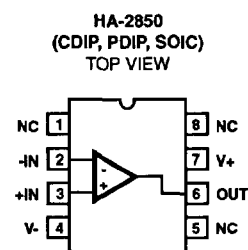
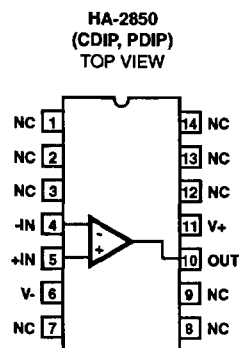
A 340V/ μ s slew rate and a 470MHz gain bandwidth product ensure high performance in video and wideband amplifier designs. Differential gain and phase are a low 0.04% and 0.04° respectively, making the HA-2850 ideal for video applications. A full ± 10 V output swing, high open loop gain, and outstanding AC parameters, make the HA-2850 an excellent choice for high speed Data Acquisition Systems.

The HA-2850 is available in commercial and industrial temperature ranges, and a choice of packages. For military grade product, refer to the HA-2850/883 data sheet.

Ordering Information

| PART NUMBER | TEMPERATURE RANGE | PACKAGE |
|-------------|-------------------|---------------------|
| HA1-2850-5 | 0°C to +75°C | 14 Lead Ceramic DIP |
| HA3B2850-5 | 0°C to +75°C | 14 Lead Plastic DIP |
| HA7-2850-5 | 0°C to +75°C | 8 Lead Ceramic DIP |
| HA3-2850-5 | 0°C to +75°C | 8 Lead Plastic DIP |
| HA9P2850-5 | 0°C to +75°C | 8 Lead SOIC |
| HA1-2850-9 | -40°C to +85°C | 14 Lead Ceramic DIP |
| HA3B2850-9 | -40°C to +85°C | 14 Lead Plastic DIP |
| HA7-2850-9 | -40°C to +85°C | 8 Lead Ceramic DIP |
| HA3-2850-9 | -40°C to +85°C | 8 Lead Plastic DIP |

Pinouts



NOTE: (NC) No Connection pins may be tied to a ground plane for better isolation and heat dissipation.

CAUTION: These devices are sensitive to electrostatic discharge. Users should follow proper I.C. Handling Procedures.
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File Number 2844.2

Specifications HA-2850

Absolute Maximum Ratings (Note 1)

| | |
|--|--------|
| Voltage Between V+ and V- Terminals | 35V |
| Differential Input Voltage | 6V |
| Junction Temperature | +175°C |
| Junction Temperature (Plastic Package) | +150°C |
| Lead Temperature (Soldering 10 Sec.) | +300°C |

Operating Conditions

| | |
|--|---------------------------------|
| Operating Temperature Range | |
| HA-2850-5 | 0°C ≤ T _A ≤ +75°C |
| HA-2850-9 | -40°C ≤ T _A ≤ +85°C |
| Recommended Supply Voltage Range | |
| | ±6V To ±15V |
| Storage Temperature Range | |
| | -65°C ≤ T _A ≤ +150°C |
| Thermal Package Characteristics (°C/W) | |
| | θ_{JA} θ_{JC} |
| 14 Lead Plastic DIP Package | 107 38 |
| 14 Lead Ceramic DIP Package | 71 14 |
| 8 Lead Plastic DIP Package | 96 34 |
| 8 Lead Ceramic DIP Package | 115 36 |
| 8 Lead SOIC Package | 157 43 |

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

Electrical Specifications V_{SUPPLY} = ±15V, R_L = 1kΩ, C_L ≤ 10pF, Unless Otherwise Specified.

| PARAMETER | TEMPERATURE | HA-2850-5, -9 | | | UNITS |
|---|-------------|---------------|------|------|---------|
| | | MIN | TYP | MAX | |
| INPUT CHARACTERISTICS | | | | | |
| Offset Voltage (Note 13) | +25°C | - | 0.6 | 2 | mV |
| | Full | - | 2 | 6 | mV |
| Average Offset Voltage Drift | Full | - | 20 | - | μV/°C |
| Bias Current (Note 13) | +25°C | - | 5 | 14.5 | μA |
| | Full | - | 8 | 20 | μA |
| Offset Current | +25°C | - | 1 | 4 | μA |
| | Full | - | - | 8 | μA |
| Input Resistance | +25°C | - | 10 | - | kΩ |
| Input Capacitance | +25°C | - | 1 | - | pF |
| Common Mode Range | Full | ±10 | - | - | V |
| Input Noise Voltage (f = 1kHz, R _{SOURCE} = 0Ω, Note 13) | +25°C | - | 11 | - | nV/√Hz |
| Input Noise Current (f = 1kHz, R _{SOURCE} = 10kΩ, Note 13) | +25°C | - | 6 | - | pA/√Hz |
| TRANSFER CHARACTERISTICS | | | | | |
| Large Signal Voltage Gain (Note 3) | +25°C | 20 | 25 | - | kV/V |
| | Full | 15 | 20 | - | kV/V |
| Common-Mode Rejection Ratio (Notes 4, 13) | Full | 75 | 80 | - | dB |
| Minimum Stable Gain | +25°C | 10 | - | - | V/V |
| Gain Bandwidth Product (Notes 5, 11, 13) | +25°C | - | 470 | - | MHz |
| OUTPUT CHARACTERISTICS | | | | | |
| Output Voltage Swing (Notes 3, 13) | Full | ±10 | ±11 | - | V |
| Output Current (Notes 3, 13) | Full | ±10 | ±20 | - | mA |
| Output Resistance | +25°C | - | 30 | - | Ω |
| Full Power Bandwidth (Notes 3, 7) | +25°C | 4.8 | 5.4 | - | MHz |
| Differential Gain (Notes 2, 6) | +25°C | - | 0.04 | - | % |
| Differential Phase (Notes 2, 6) | +25°C | - | 0.04 | - | Degrees |
| Harmonic Distortion (Notes 6, 12, 13) | +25°C | - | -74 | - | dBc |

2
OPERATIONAL
AMPLIFIERS

Specifications HA-2850

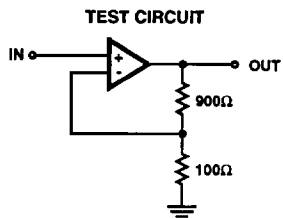
Electrical Specifications $V_{SUPPLY} = \pm 15V$, $R_L = 1k\Omega$, $C_L \leq 10pF$, Unless Otherwise Specified. (Continued)

| PARAMETER | TEMPERATURE | HA-2850-5, -9 | | | UNITS |
|--|-------------|---------------|-----|-----|------------|
| | | MIN | TYP | MAX | |
| TRANSIENT RESPONSE (Note 8) | | | | | |
| Rise Time | +25°C | - | 5 | - | ns |
| Overshoot | +25°C | - | 25 | - | % |
| Slew Rate (Notes 3, 10, 13) | +25°C | 300 | 340 | - | V/ μ s |
| Settling Time: 10V Step to 0.1% | +25°C | - | 200 | - | ns |
| POWER REQUIREMENTS | | | | | |
| Supply Current (Note 13) | Full | - | 7.5 | 8.0 | mA |
| Power Supply Rejection Ratio (Notes 9, 13) | Full | 75 | 90 | - | dB |

NOTES:

1. Absolute maximum ratings are limiting values, applied individually, beyond which the serviceability of the circuit may be impaired. Functional operability under any of these conditions is not necessarily implied.
2. Differential gain and phase are measured with a VM700A video tester, using a NTC-7 composite VITS.
3. $R_L = 1k\Omega$, $V_O = \pm 10V$, 0V to $\pm 10V$ for slew rate.
4. $V_{CM} = \pm 10V$.
5. $V_O = 90mV$.
6. $A_V = +10$.
7. Full Power Bandwidth guaranteed based on slew rate measurement using $FPBW = \frac{\text{Slew Rate}}{2\pi V_{PEAK}}$; ($V_{PEAK} = 10V$).
8. Refer to Test Circuit section of data sheet.
9. $V_{SUPPLY} = \pm 10VDC$ to $\pm 20VDC$.
10. This parameter is not tested. The limits are guaranteed based on lab characterization, and reflect lot-to-lot variation.
11. $A_V = +100$.
12. $V_O = 2V_{p-p}$, $f = 1MHz$
13. See "Typical Performance Curves" for more information.

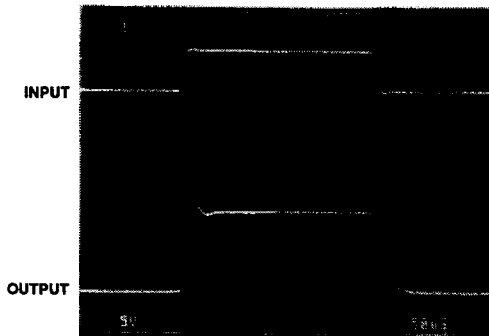
Test Circuit



NOTE:
 $V_S = \pm 15V$
 $A_V = +10$
 $C_L < 10pF$

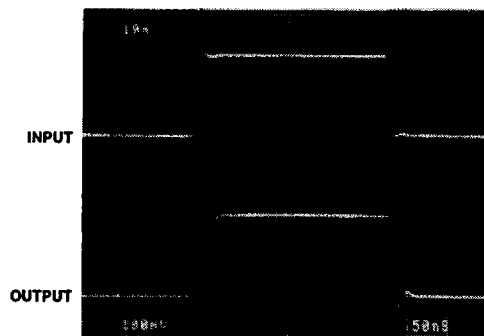
LARGE SIGNAL RESPONSE

Input = 1V/Div.
 Output = 5V/Div.
 50ns/Div.

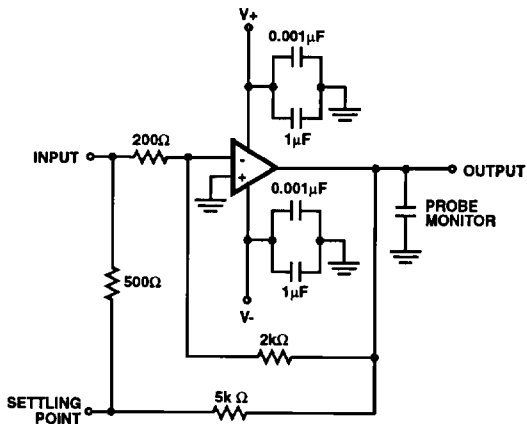


SMALL SIGNAL RESPONSE

Input = 10mV/Div.
 Output = 100mV/Div.
 50ns/Div.



SETTLING TIME TEST CIRCUIT



- $A_V = -10$
- Load Capacitance should be less than 10pF.
- It is recommended that resistors be carbon composition and that feedback and summing network ratios be matched to 0.1%.
- SETTLING POINT (Summing Node) capacitance should be less than 10pF. For optimum settling time results, it is recommended that the test circuit be constructed directly onto the device pins. A Tektronix 568 Sampling Oscilloscope with S-3A sampling heads is recommended as a settle point monitor.

HA-2850

Die Characteristics

DIE DIMENSIONS:

65 x 52 x 19 ± 1mils
(1650 x 1310 x 483µm)

METALLIZATION:

Type: Aluminum, 1% Copper
Thickness: 16kÅ ± 2kÅ

GLASSIVATION:

Type: Nitride over Silox
Silox Thickness: 12kÅ ± 2kÅ
Nitride thickness: 3.5kÅ ± 1kÅ

DIE ATTACH:

Material: Epoxy-Plastic DIP and SOIC
Gold Eutectic-Ceramic DIP

WORST CASE CURRENT DENSITY:

0.7×10^5 A/cm² at 1.8mA

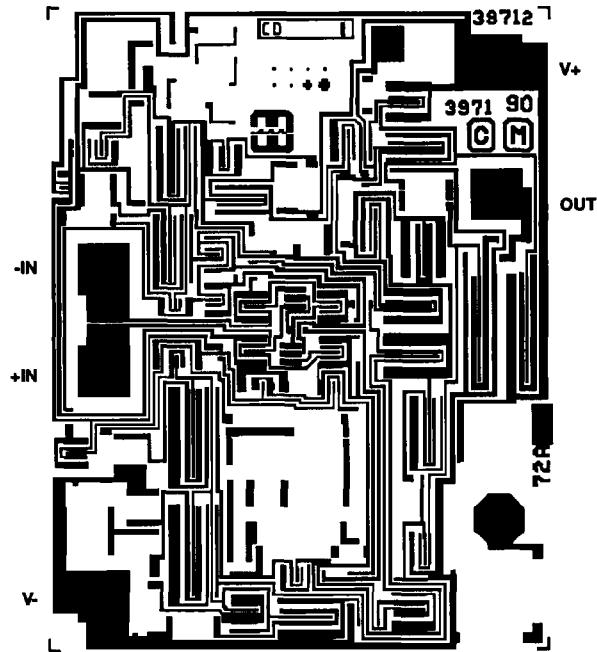
SUBSTRATE POTENTIAL (POWERED UP): V-

TRANSISTOR COUNT: 34

PROCESS: High Frequency Bipolar Dielectric Isolation

Metallization Mask Layout

HA-2850



Typical Performance Curves $T_A = +25^\circ\text{C}$, $V_{\text{SUPPLY}} = \pm 15\text{V}$, $R_L = 1\text{k}\Omega$, $C_L < 10\text{pF}$, Unless Otherwise Specified

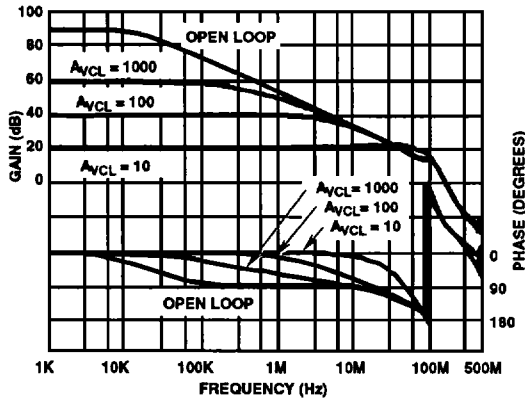


FIGURE 1. FREQUENCY RESPONSE FOR VARIOUS GAINS

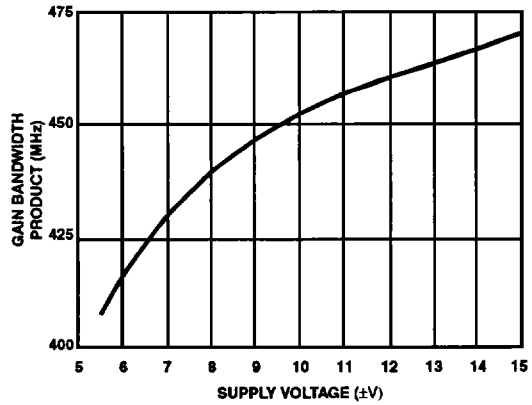


FIGURE 2. GAIN BANDWIDTH PRODUCT vs SUPPLY VOLTAGE

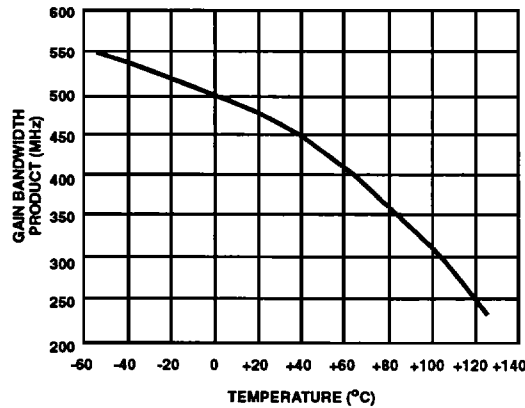


FIGURE 3. GAIN BANDWIDTH PRODUCT vs TEMPERATURE

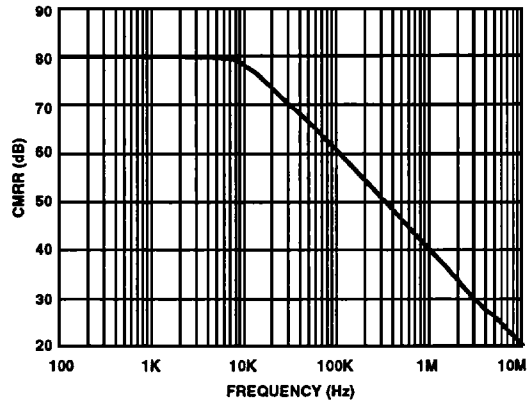


FIGURE 4. CMRR vs FREQUENCY

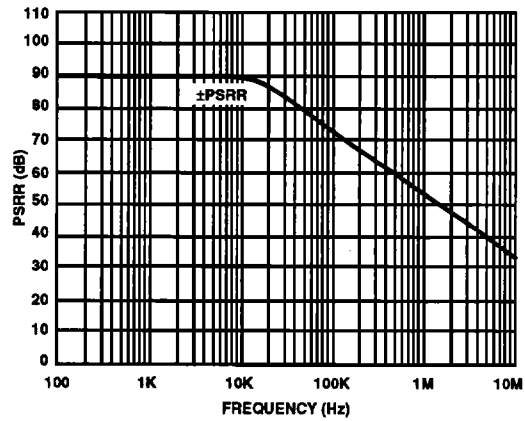


FIGURE 5. PSRR vs FREQUENCY

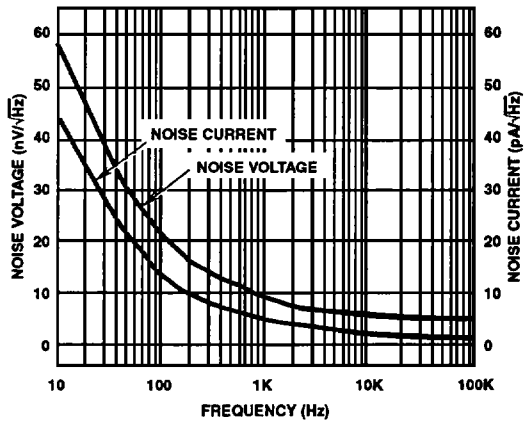


FIGURE 6. INPUT NOISE vs FREQUENCY

Typical Performance Curves $T_A = +25^\circ\text{C}$, $V_{\text{SUPPLY}} = \pm 15\text{V}$, $R_L = 1\text{k}\Omega$, $C_L < 10\text{pF}$, Unless Otherwise Specified (Continued)

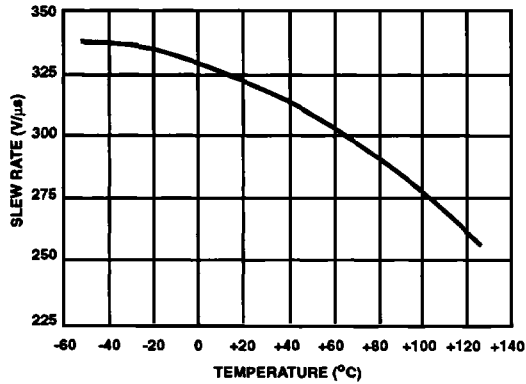


FIGURE 7. SLEW RATE vs TEMPERATURE

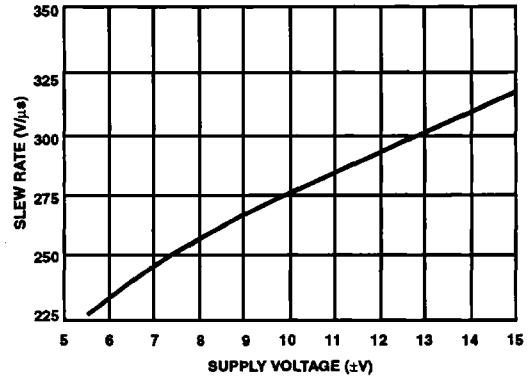


FIGURE 8. SLEW RATE vs SUPPLY VOLTAGE

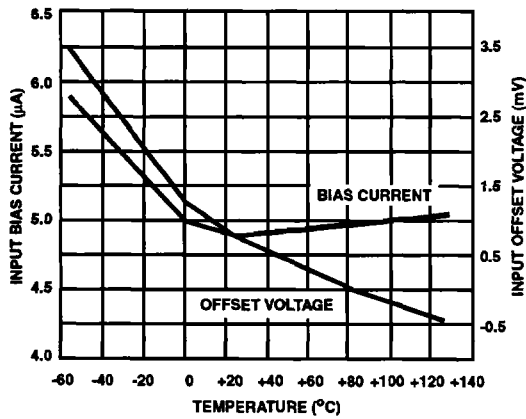


FIGURE 9. INPUT OFFSET VOLTAGE AND INPUT BIAS CURRENT vs TEMPERATURE

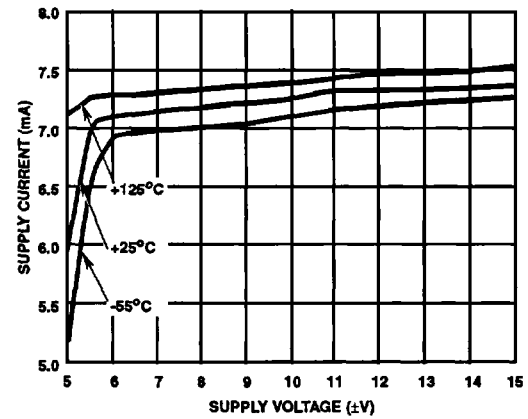


FIGURE 10. SUPPLY CURRENT vs SUPPLY VOLTAGE

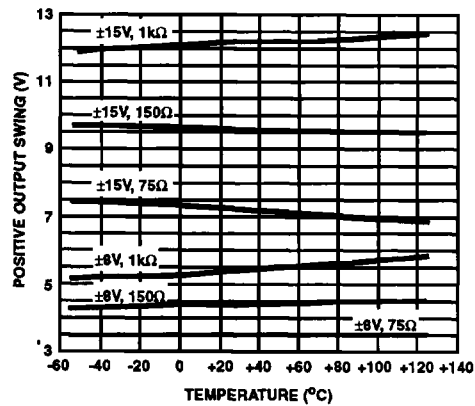


FIGURE 11. POSITIVE OUTPUT SWING vs TEMPERATURE

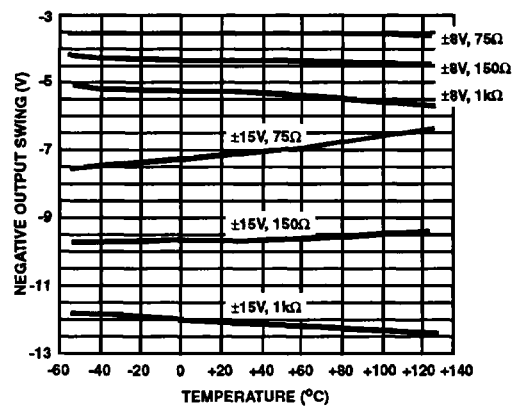


FIGURE 12. NEGATIVE OUTPUT SWING vs TEMPERATURE

Typical Performance Curves $T_A = +25^\circ\text{C}$, $V_{\text{SUPPLY}} = \pm 15\text{V}$, $R_L = 1\text{k}\Omega$, $C_L < 10\text{pF}$, Unless Otherwise Specified (Continued)

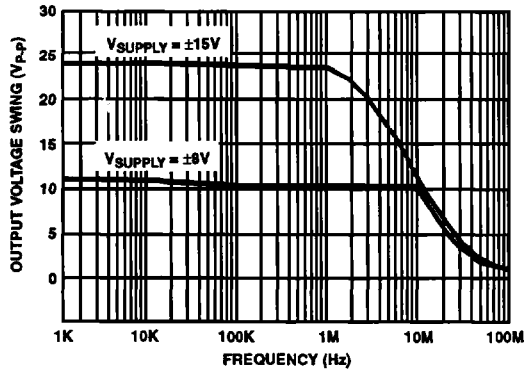


FIGURE 13. MAXIMUM UNDISTORTED OUTPUT SWING vs FREQUENCY

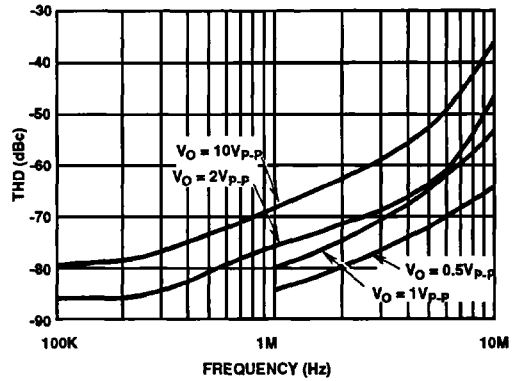


FIGURE 14. TOTAL HARMONIC DISTORTION vs FREQUENCY

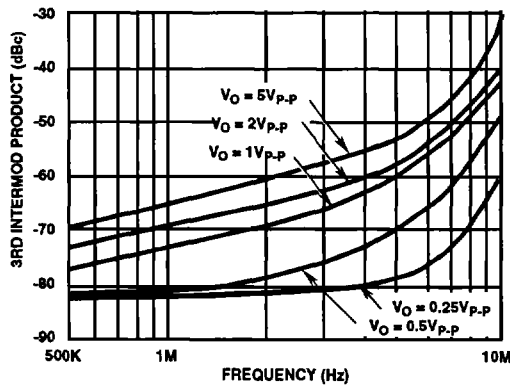


FIGURE 15. INTERMODULATION DISTORTION vs FREQUENCY (2 TONE)